OFF-PLANT OU HUMAN HEATH IMPLEMENTATION STUDY

IMPLEMENTATION ACTIONS – HUMAN HEALTH REMEDY
Off-Plant OU, EMF[1]
June 2020

Post ROD Monitoring and Assessment

Remedial Action Objective
The overall objective of the selected remedy for the EMF Superfund Site is "to provide an effective mechanism for protecting human health and the environment from risks associated with contaminated site soils and ground water".

The following cleanup/remedial action objectives (RAOs) were developed to address potential human health risks from exposures at the Off-Plant OU:

> *Prevent future consumption of homegrown produce grown in areas of the Site where soil constituents' levels result in a potential noncarcinogenic risk exceeding a hazard quotient (HQ) of 1.*
>
> *Prevent external exposure to radium-226 in soils at levels that pose cumulative estimated excess risk above 1 x 10^{-4}.*

The Selected Remedy
To address potential impacts to human health, the EPA selected the following remedy.

> *Implement legally enforceable land use controls and monitoring in the Off-Plant area to restrict property use due to potential exposure to radionuclides in soils and inform future property owners of the potential human health risks associated with consumption of homegrown fruits and vegetables*. (ROD, Declaration)

Additional detail is provided in Section 10 of the ROD.

> *<u>Areas subject to land use controls</u> - These are areas where soil contaminant levels exceed a HQ of 1 for cadmium (RME case) and/or which poses a 1 in 10,000, or greater, excess risk from radium-226 as shown in Figures 27 and 28. These areas include the Interstate 86 Right-of-Way (51 acres); Chevron Tank Farm (20 acres); City of Pocatello Property (326 acres); a portion of the land owned by a private party named R. Rowland, and a portion of BLM lands to the SW of the FMC facility. In this area the PRPs shall implement legally enforceable land use controls (purchase of a recorded easement with accompanying deed restriction) restricting the use of agricultural products grown thereon for human consumptions due to the presence of cadmium in soils. For those areas contaminated with radium-226 legally enforceable land use controls shall be implemented to prevent future residential use.*
>
> *<u>Areas Subject to Company Monitoring for Residential Development</u> - This area is shown in Figure 29 and was not found to exceed the criteria established for the imposition of Land Use Controls but was either close enough to the threshold, or adjacent to lands that exceeded the threshold, to warrant notification to current and future property owners if residential use is likely to occur. In this area the PRPs shall monitor property use for residential development and inform residential property owners of potential human health risks*

[1] Jeremy Jennings, Remedial Project Manger, Superfund and Emergency Management Program, EPA Region 10. Seattle, WA. June 2020.

associated with consumption of homegrown fruits and vegetables due to the presence of cadmium in soils. Similar restrictions on use of agricultural products could be implemented on such areas, as necessary.

In conjunction with this monitoring and land use controls described above, the PRPs shall develop a test program to evaluate actual uptake into produce which may be grown by residents in the affected off-plant areas. A monitoring plan including a quality assurance program plan and a sampling plan shall be submitted for EPA approval during the remedial design. Cadmium concentrations in the soil and produce shall be measured over multiple growing seasons. The results of the test program will be used to determine if monitoring and land use controls are still required or if any additional action is necessary to prevent potential health risks associated with consumption of homegrown fruits and vegetables.

[Figures 27, 28 and 29 have been reproduced as Figures 2, 3 and 4.]

Implementation of the Remedy

In late 2001, FMC closed the Pocatello facility, thus removing the primary source of cadmium and radium-226 to the Off-Plant OU. In 2009, soil samples were collected to evaluate post-closure conditions and determine where land use controls were required or warranted.

2009 Soil Sampling Event

In 2009, soils in the Off-Plant OU were sampled consistent with the *Eastern Michaud Flats Superfund Site Off-Plant OU Supplemental Surface Soil Radionuclide Investigation Work Plan*, approved by EPA on October 2, 2009 (MWH, 2009). A total of 10 multi-increment soil samples were collected from each of eight Decision Units (DU) (Figure 5*)*. Consistent with the Conceptual Site Model that identified air emissions as the primary source, the eight DUs were selected in areas nearest to the plants and downwind of emission sources. Initially the samples were analyzed for three radionuclides – lead-210, radium-226 and uranium-238. Later, the same samples were analyzed for cadmium, fluoride, thallium and vanadium.

Cadmium Results

The cadmium concentrations measured in the 2009 soil samples are identified in a May 3, 2010 letter to EPA (FMC, 2010) and are summarized in Table 1. Cadmium concentrations collected from the top two inches of soil were higher than those collected at greater depths at all sites except DU3. [At DU3, the sample collected from 2-6 inches had a slightly higher concentration than the surface sample (mean = 4.8 vs 4.6 mg/kg).] The highest concentrations of cadmium were found in DU2 where the 95% upper confidence level (UCL) was reported at 10.8 mg/kg, less than the 16.9 mg/kg threshold concentration.

Radionuclide Results

The radionuclide data from the 2009 sampling event were reported in the *Off-Plant OU Supplemental Surface Soil Radionuclide Investigation Report* (MWH, 2010) and are summarized in Table 2. Radionuclide activities were found to be highest in DUs 2 and 8 (immediately north of the FMC and Simplot plants) and at or near background in the other DUs. As with the cadmium concentrations, radionuclide activities decreased with distance from the sources and with soil depth.

Results for Fluoride and Other Contaminants of Potential Concern (COPCs)

Fluoride, thallium and vanadium concentrations were measured, and the uranium concentration estimated for each DU for use in a comprehensive reevaluation of human health risks at the OU. The data were presented in the *Comprehensive Letter Report Documenting Potential Human Health Risks for Site COCs in the Off-Plant OU* (Hanna, 2011) and is summarized in Table 3. All reported values were below the established risk thresholds.

In-Situ Gamma Ray Measurements

To further assess radium-226, a series of in-situ gamma-ray measurements and soil moisture samples were collected from soils located within 1.4 and 2.4 miles of the former FMC and current Simplot plants. Sampling was conducted by EPA and analyzed by the EPA Office of Radiation and Indoor Air in Las Vegas, Nevada. Sampling

locations were chosen, in part, based on recommendations from the Shoshone-Bannock Tribes. Tribal representatives were present during the sampling.

The analysis indicated radium-226 activities to be slightly lower in the areas north of the plants as compared to areas to the south. The variability appeared to be due to either the higher rate of development, and thus ground disturbance, in the northern area or geological differences between the two areas. A statistical analysis indicated that the in-situ gamma-ray measurements were comparable to the in-situ background measurements taken during the FMC Supplemental Remedial Investigation (MWH, 2010). The analysis found it unlikely that the differences were due to windblown particulate, fertilizer or placement of FMC's slag on area roads. Based on the data and analysis, it was determined that airborne deposition of radium-226 released in air emissions had not affected the levels of radium-226 in the Off-Plant OU.

Reevaluation of Cadmium Uptake Rate
Cadmium ingested via homegrown fruit and produce has been identified as one of the routes of potential exposure to residents. Due to uncertainties in data, the human health remedy required monitoring of land use and residential development and, if changes occur, develop a test program to evaluate actual cadmium uptake into produce. areas with cadmium levels close to the thresholds or adjacent to land use additional test program to determine if further monitoring or land use controls were required.

During the 2009 growing season the companies monitored several garden plots to determine cadmium levels in soils and produce and used the data to calculate an uptake rate for use in the human health risk assessment (FMC, Dec 8, 2009). Based on the results of that assessment, it was determined that land use controls were not needed to prevent health risks associated with consumption of homegrown produce in the Off-Plant OU.

Human Health Risk Reassessment
A *Comprehensive Letter Report Documenting Potential Human Health Risks for Site COCs in the Off-Plant OU* (Hanna, 2011) was developed to quantify potential human health risks using data and analysis generated since the RI. Initially, the assessment only addressed radionuclides and the results presented in the *Supplemental Surface Soil Radionuclide Investigation Report for the Off-Plant OU* (MWH, 2010). However, following review of that report, a comprehensive evaluation was developed to assess total risks for residents and industrial/commercial workers in the OU.

The new data were first compared to the risk-based screening Comparative Values (CVs) identified in the risk assessment recently completed for the FMC-owned Northern Properties (MWH, 2010). Where the mean contaminant concentration exceeded the CV, a quantitative risk assessment was completed. Cadmium, radium-226 and lead-210 were the only contaminants identified at levels greater than the residential CV while none of the contaminants exceeded the industrial/commercial worker CVs. Potential risks were calculated for the DUs where the CVs were exceeded. These units are presented in Table 4.

Noncarcinogenic Risks
Using a residential scenario, hazard quotients (HQ) were calculated for total, incremental and background risks in DU 1-5, 7 and 8. These are presented in Table 5.

The incremental HQ for each DU was either 0.6 or 0.7, both below the noncarcinogenic risk threshold of HQ=1 identified in the ROD. The primary noncarcinogenic risk driver was found to be exposure to cadmium through ingestion of homegrown produce was identified as the primary noncarcinogenic risk driver. All HQs were lower than those derived during the 1996 baseline risk assessment, consistent with what would be expected following the removal of a source. This downward trend is expected to continue in the future. Thus, EPA finds that no further actions, including monitoring, are required to prevent human health risks from noncarcinogens found in surface soils in the Off-Plant OU.

Carcinogenic Risks
Using a residential scenario, hazard quotients (HQ) were calculated for total, incremental and background risks for radium-226 and lead-201 in DU 2 and radium-226 in DU 8. The results are summarized in Table 6.

In both DU 2 and DU 8, the total risks were calculated to be $1x10^{-4}$ (1 in 10,000). However, background concentrations accounted for 75 to 80% of the total potential risk. When considering only risks from sources originating from FMC and Simplot sources (the scope of this remedial action), An incremental carcinogenic risk of $3x10^{-5}$, was calculated for DU 2 and 8, below the $1x10^{-4}$ threshold established in the 1998 ROD. Thus, EPA finds that no further actions, including monitoring, are required to prevent human health risks from carcinogens found in surface soils in the Off-Plant OU.

Native American Risk Scenario
The Tribes requested a Native American Risk Scenario be completed as part of the human health risk assessment. In the absence of further information regarding tribal exposure pathways (e.g. specific species gathered, grown and ingested), the EPA reviewed the exposure assumptions used for the residential scenario and found them to be conservative in comparison to a likely Native American exposure.

Consumption of cadmium in homegrown produce was identified as the major pathway of concern. Potential residential risks were calculated using the 95^{th} percentile consumption rate for produce (5% of the US population would consume greater than this rate). Since this value assumes that all produce consumed was harvested from gardens within the individual decision units. The traditional gathering habits of the local tribes, it would be expected that plants would be gathered from a variety of ecological settings. Thus, the EPA considers this assumption and the risk calculation conservative for both the residential and Native Americans or subsistence use scenarios. Thus, the EPA finds that no further action to prevent human health risks to Native Americans or subsistence users in the Off-Plant OU.

Summary of Supplemental Findings
In summary, the supplemental sampling and assessment indicate:

- Noncarcinogenic human health risks associated with soils in the Off-Plant OU have a hazard quotient of less than 1 (HQ<1). Cadmium is the primary noncarcinogen of concern. Fluoride in soils do not pose an unacceptable human health risk.

- The incremental carcinogenic risks, where quantified, were $3x10^{-5}$, less than the $1x10^{-4}$ threshold established in the ROD. Radium-226 and, to a lesser extent, lead-210 are the primary carcinogens of concern. Background sources of radionuclides are far more significant than sources that originated from the FMC and Simplot operations.

- Elevated levels of cadmium, radium-226 and lead-210 detected in soil samples collected in the Off-Plant OU decrease with distance from the two plants and with soil depth. Site-related air deposition is the primary source of these contaminants. Air emissions from the now-closed FMC Plant are the only source of the COCs to the Off-Plant OU. 2009 concentrations of all COCs were less than those reported in the RI.

Implementation of Land Use Controls and Residential Notification
The soil remedy selected in the ROD for the Off-Plant OU was presented in two parts: Areas Subject to Land Use Controls and Areas Subject to Company Monitoring for Residential Development.

Areas Subject to Land Use Controls
Cadmium
The 1998 ROD required legally enforceable land use controls be implemented in all areas of the Off-Plant OU where the HQ > 1. As discussed above, supplemental sampling and a risk assessment have been conducted to

evaluate conditions following the closure of the FMC Plant and thus, removal of the source. The supplemental sampling confirmed that cadmium was the only noncarcinogen that exceeded the human health screening level. Hazard quotient of 0.6 and 0.7 were calculated for DUs where the maximum soil concentrations exceeded the CV, below the threshold (HQ=1) identified in the ROD. Fluoride and other noncarcinogens were not found at levels that warrant a quantitative human health risk evaluation. The primary source of cadmium, air emissions from FMC stacks, was removed when in 2001 when the FMC plant closed. Since there is no longer an active source, cadmium levels are likely to continue to decrease.

Based on this review, the EPA finds that, for cadmium, no land use controls, or further monitoring are required. In addition, since the primary site source has been removed, the EPA finds that no land use controls are likely to be needed in the future. Thus, the EPA finds that the cleanup/remedial objectives for cadmium in soils have been attained.

Radium-226
The 1998 ROD requires legally enforceable land use controls in areas of the Off-Plant OU that pose a 1×10^{-4} or greater excess cancer risk from radium-226. As discussed above, supplemental sampling and a risk assessment have been conducted to further delineate the specific areas where control actions were required. The supplemental sampling confirmed that radium-226 and iron-210 were the only carcinogens present at levels of potential concern. In addition, the supplemental human health risk assessment did not identify any areas in the Off-Plant OU where the potential risks from carcinogens were greater than 1 in 10,000, the threshold established in the ROD. Furthermore, air emissions were identified as the primary site source of both radium-226 and lead-210 and the primary site source of these two contaminants was identified as the air emissions from FMC stacks. This source was eliminated with the closure of the FMC plant in 2001.

Based on this review, EPA finds that the remedy does not require any land use controls to be implemented in the Off-Plant OU to address potential risks from radium-226 or other carcinogens. In addition, since the primary site source has been eliminated, EPA finds that no additional controls are likely to be needed in the future. Thus, EPA finds that the cleanup objectives for radium-226 in soils have been attained.

Areas Subject to Company Monitoring for Residential Development
The selected remedy required notification to residential property owners "close enough to the threshold" to "warrant notification" or "adjacent to lands that exceeded the threshold". As discussed above, the human health thresholds were not exceeded under the 2009 scenario. EPA finds that this is not close enough to the threshold of HQ=1 to warrant any additional monitoring or notification to landowners. Without ongoing emissions, the level of cadmium in, or risks from, surface soils are not expected to increase in the future. Based on these findings, EPA finds that no additional monitoring or notification of residential property owners is warranted.

The provision also required notification on properties "adjacent to lands that exceeded the threshold". As discussed above, the supplemental sampling and risk analysis did not identify any area within the Off-Plant OU that exceeded the noncarcinogenic threshold (HQ=1). In addition, supplemental studies completed in 2009 and 2010 on the FMC Northern Properties immediately adjacent to the southern edge of the Off-Plant OU indicated the boundary parcels did not exceed the noncarcinogenic threshold (MWH, 2010b). As such, EPA has not identified no properties where notification is required.

Document Summary
This document provides the documentation of the information used to delineate where additional land use controls to address human health risks in the Off-Plant OU are required.

Based on this information, an updated human health risk assessment indicates that risks presented by cadmium, radium-226 and other contaminants are less than the thresholds identified in the ROD. The evaluation shows that no land use controls are required under the remedy to address human health concerns and no further notification of nearby residents is warranted. For purposes of CERCLA, no hazardous substances, pollutants or contaminants that may impair human health remain above levels that could prevent unlimited use and unrestricted exposure to humans.

Table 1. Cadmium Concentrations Measured in Soils
2009 Off-Plant OU Sample Event

Decision Unit	Mean Concentration 0-2" depth (mg/kg)	95% UCL Concentration (mg/kg)
1	4.8	5.1
2	10.3	10.8
3	4.6	5.0
4	5.2	5.6
5	5.3	5.6
6	2.1	2.3
7	3.3	4.6
8	6.5	8.0

Risk Threshold =16.9

Table 2. Summary of COPC Concentrations (mg/kg) in Soils (0 to 2 inches)
2009 Off-Plant OU Sample Event

Decision Unit	**Fluoride**		**Thallium**		**Uranium**		**Vanadium**	
	Mean	**95% UCL**	**Mean**	**95% UCL**	**Mean**	**95% UCL**	**Mean**	**95% UCL**
Background	--	302	--	0.13	--	0.66	--	19.6
1	318	382	0.21	0.22	3.0	3.3	18	18
2	480	634	0.25	0.27	2.9	3.5	30	34
3	353	412	0.19	0.20	3.4	3.7	23	24
4	370	441	0.19	0.20	3.2	3.5	24	25
5	326	376	0.20	0.21	3.4	3.6	25	27
6	203	247	0.15	0.15	3.1	3.3	13	13
7	198	233	0.17	0.18	3.0	3.7	14	15
8	608	773	0.18	1.20	3.9	4.7	24	26

Table 3. Radionuclide Activities (pCi/g) in Soils (0 to 6 inches)
2009 Off-Plant OU Sample Event

Decision Unit	Radium-226		Lead-210		Uranium-238	
	Mean	95% UCL	Mean	95% UCL	Mean	95% UCL
Background	--	1.21	--	1.46	--	0.96
1	1.21	1.30	1.42	1.47	1.03	1.14
2	1.64	1.73	1.99	2.22	1.16	1.31
3	1.03	1.14	1.36	1.43	1.15	1.23
4	0.98	1.13	1.30	1.36	1.01	1.08
5	1.04	1.16	1.46	1.52	1.19	1.29
6	0.93	1.04	1.32	1.39	0.96	1.02
7	1.00	1.14	1.37	1.52	1.16	1.46
8	1.50	1.73	1.67	1.93	1.26	1.45

Table 4. Contaminants and Decision Units Quantitatively Assessed
Human Health Risk Assessment, Off-Plant OU

Contaminant	Background Concentration (95% UCL on the Mean)	Residential CV	DUs where Risks Quantified	Non-Carcinogen	Carcinogen
Radium-226	1.21	1.22	2, 8	--	X
Lead-210	1.46	1.91	2	--	X
Uranium-238	0.96	1.74	--	--	--
Cadmium	0.72	3.1	1-5, 7, 8	X	--
Fluoride	302	772	--	--	--
Thallium	0.13	0.64	--	--	--
Uranium	0.66	5.3	--	--	--
Vanadium	19.6	58.64	--	--	--

Table 5. Quantitative Results of Human Health Risk Assessment for Noncarcinogens Off-Plant OU

Decision Unit	Hazard Quotient for RME Residential Exposure Scenario*			Primary Exposure Route
	Total	Background	Incremental	
1	0.8	0.1	0.6	Homegrown Produce
2	0.8	0.1	0.7	Homegrown Produce
3	0.8	0.1	0.6	Homegrown Produce
4	0.8	0.1	0.6	Homegrown Produce
5	0.8	0.1	0.6	Homegrown Produce
6	--	--	--	Below screening level
7	0.8	0.1	0.6	Homegrown Produce
8	0.8	0.1	0.7	Homegrown Produce

* Due to the rounding of all values to nearest tenth of a unit, in some instances the total HQ appears to be greater than the sum of the background plus incremental.

Table 6. Quantitative Results of Human Health Risk Assessment for Carcinogens Off-Plant OU

Decision Unit	Carcinogenic Risks for RME Residential Exposure Scenario*			Primary Risk Drivers
	Total	Background	Incremental	
2	1×10^{-4}	1×10^{-4}	3×10^{-5}	Radium-226, Lead-210
8	1×10^{-4}	9×10^{-5}	3×10^{-5}	Radium-226

* Due to the rounding of all values to nearest tenth of a unit, in some instances the total HQ appears to be greater than the sum of the background plus incremental.

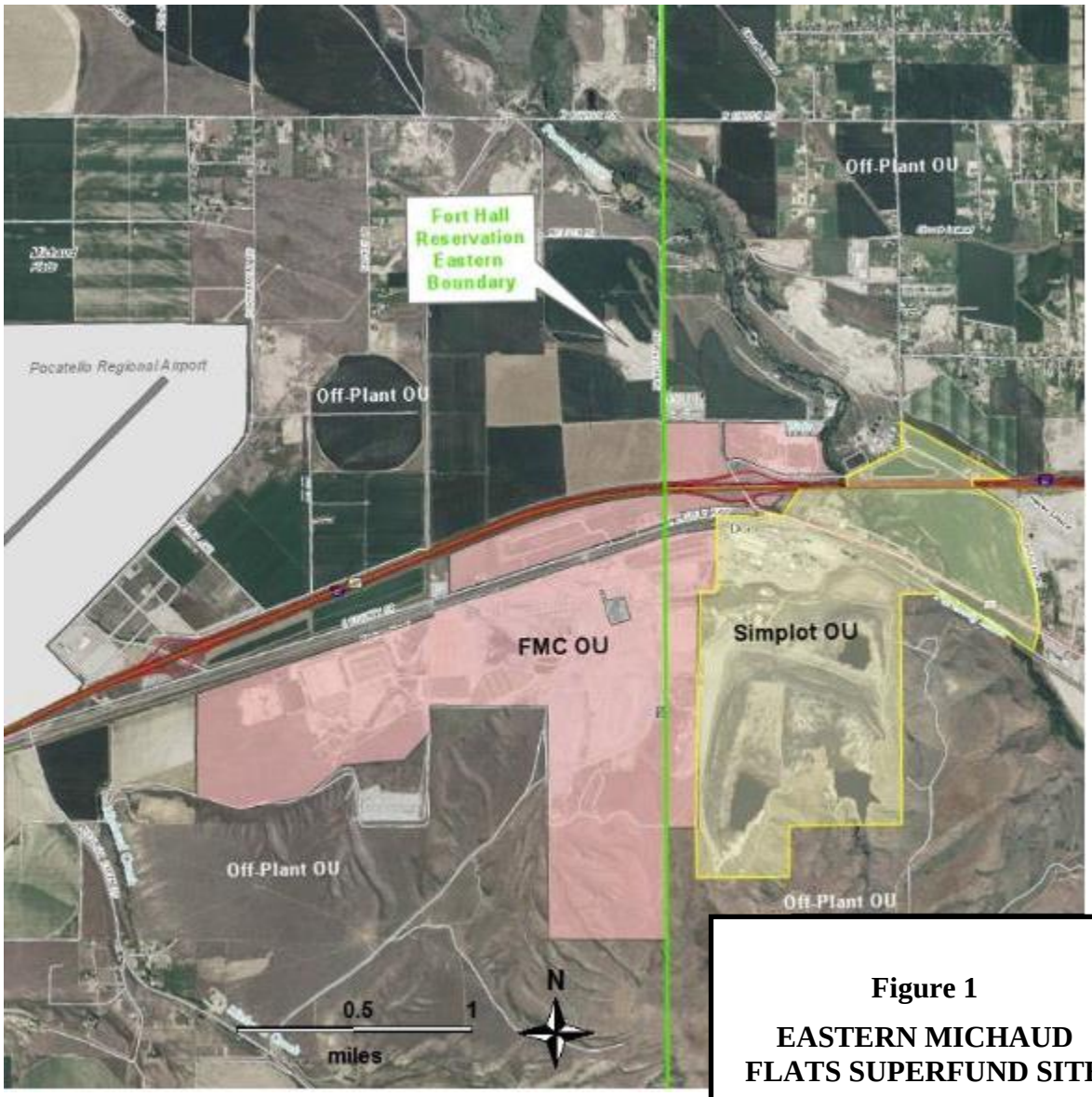
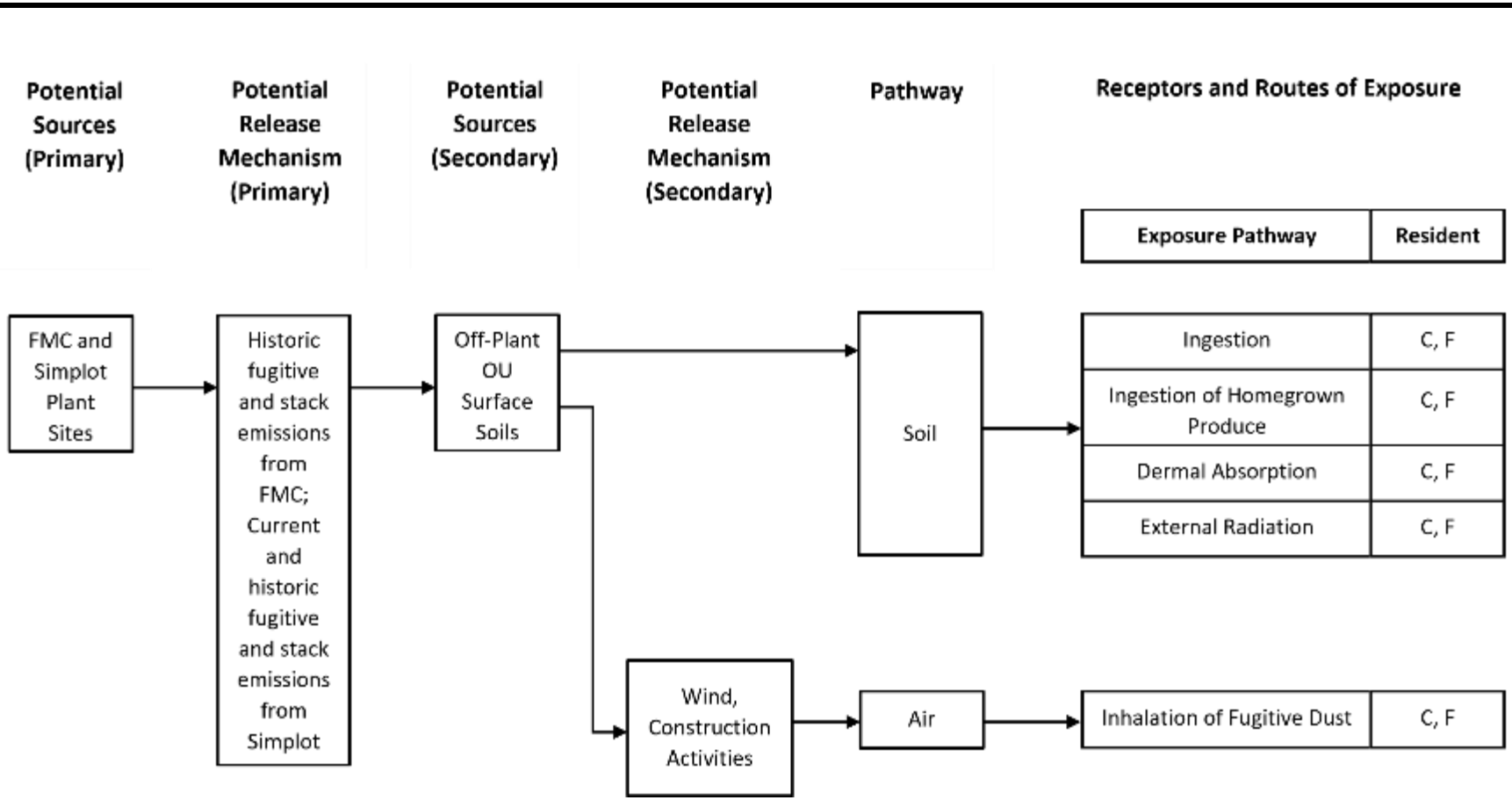


Figure 1

EASTERN MICHAUD FLATS SUPERFUND SITE

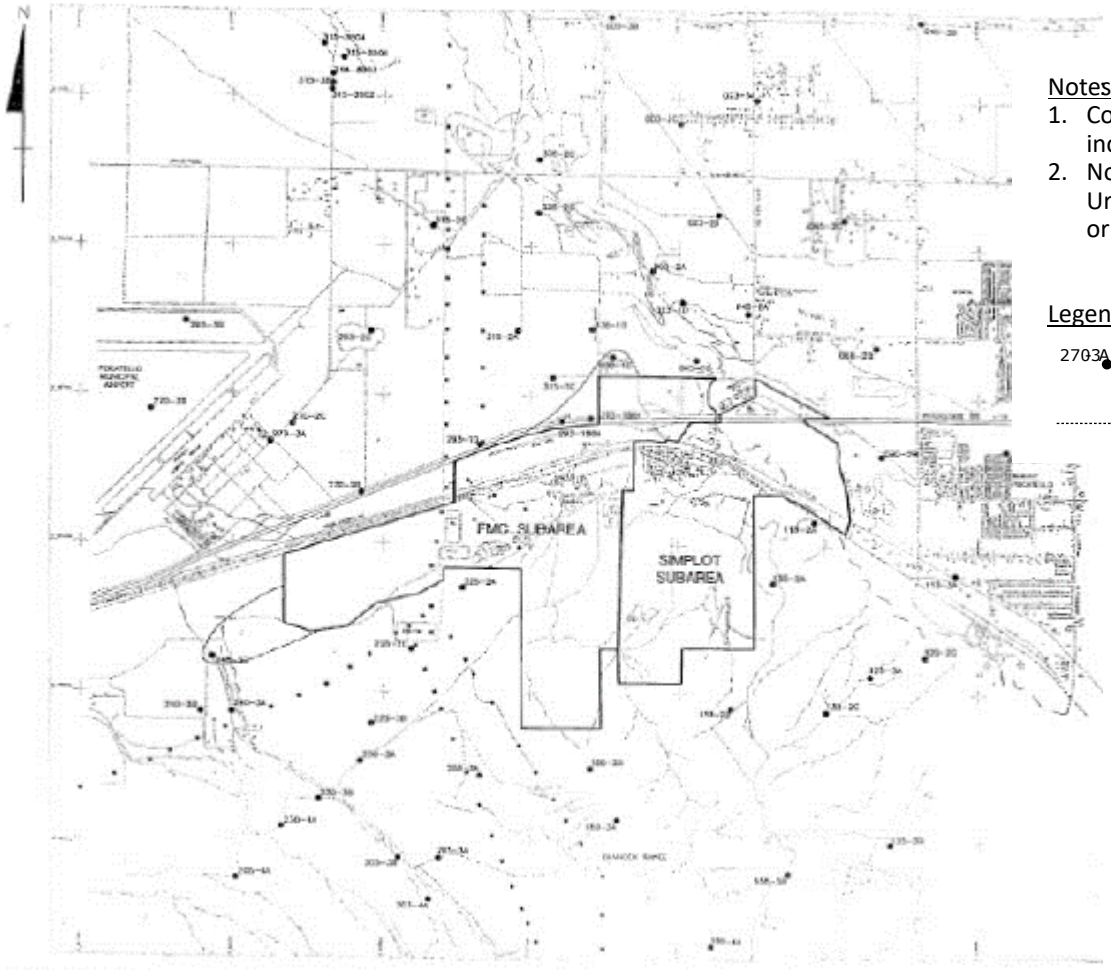


C = Complete path under 1998 conditions.

F = Complete path under future conditions

Figure 2

CONCEPTUAL SITE MODEL FOR POTENTIAL HUMAN EXPOSURE TO COPCs/ROPCs IN THE OFF-PLANT OU



Notes

1. Contours shown correspond to incremental cancer risk of 10^{-4}
2. No areas exceed 10^{-4} risk for Uranium-238, Polonium-210, or Lead-210.

Legend

2703A ● Soil sampling location and designation

..... Radium-226

Figure 3

OFF-SITE SUBAREA AREAS WHERE RADIONUCLIDE ACTIVITIES IN SURFACE SOILS EXCEED THE 10^{-4} INCREMENTAL CANCER RISK LEVELS

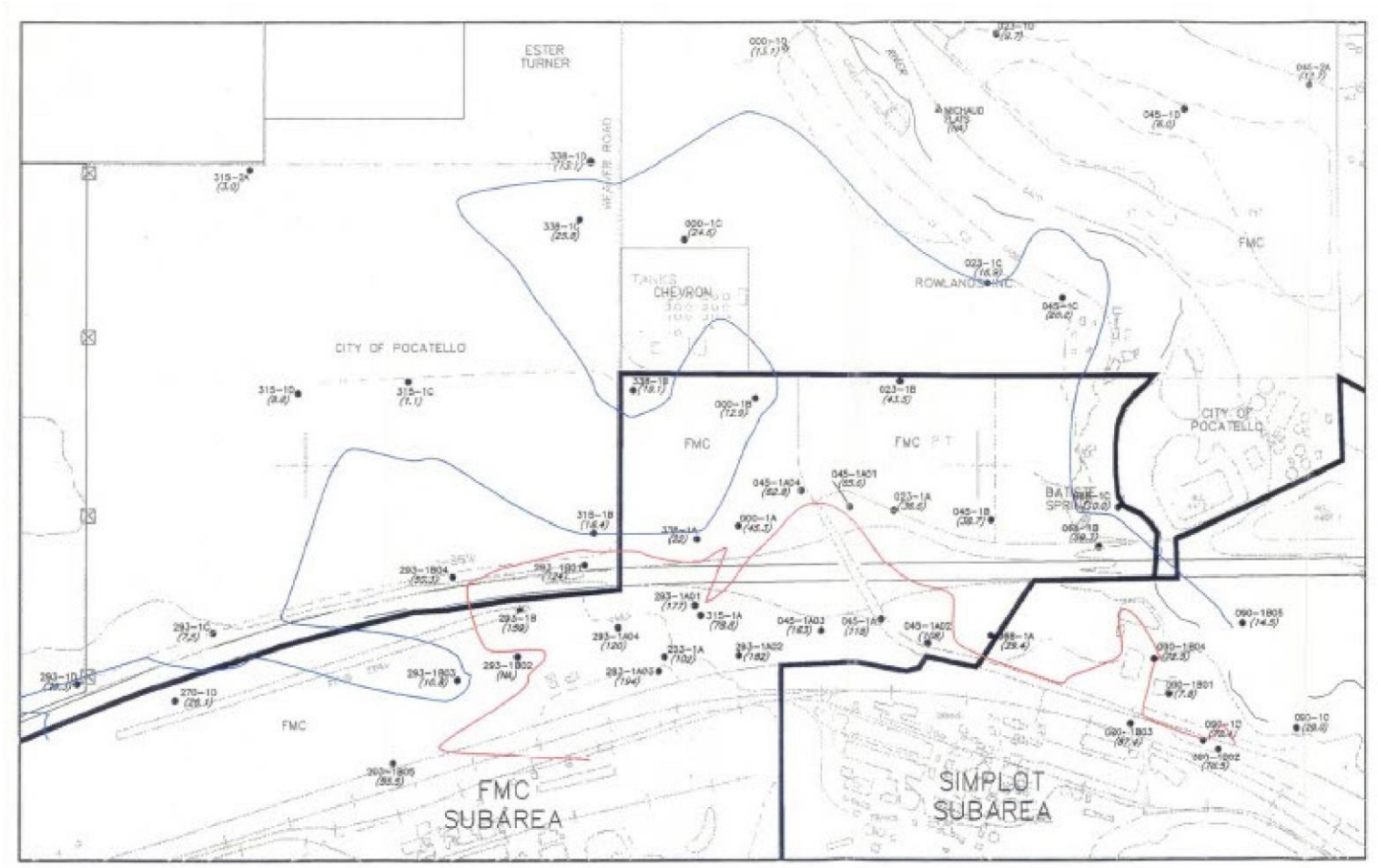


Figure 4

OFF-SITE SUBAREA AREAS WHERE CADMIUM CONCENTRATIONS IN SURFACE SOIL EXCEED LEVELS EQUIVALENT TO A HAZARD QUOTIENT OF ONE

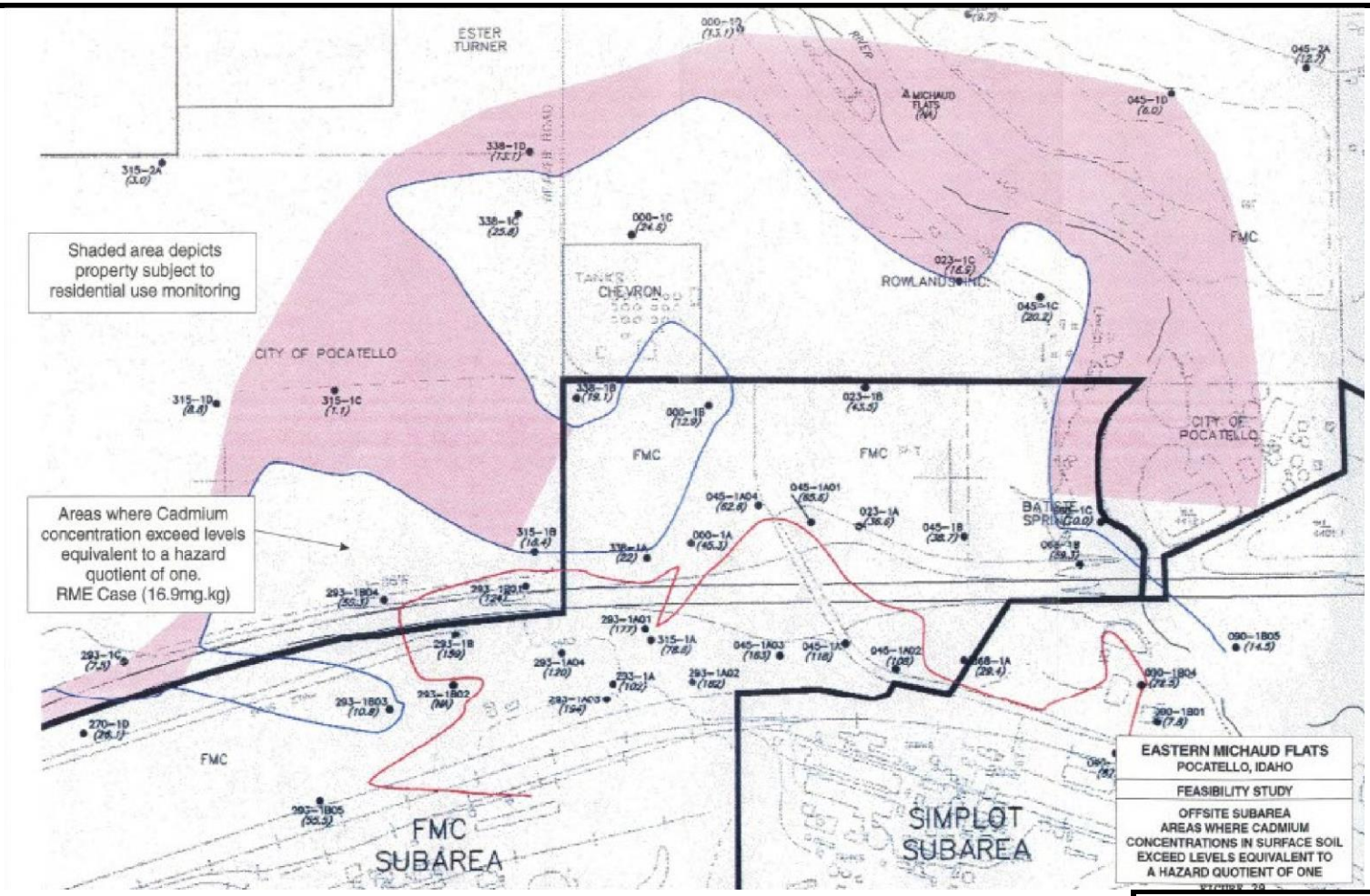


Figure 5

OFF-SITE SUBAREA AREAS WHERE CADMIUM CONCENTRATIONS IN SURFACE SOIL EXCEED LEVELS EQUIVALENT TO A HAZARD QUOTIENT OF ONE

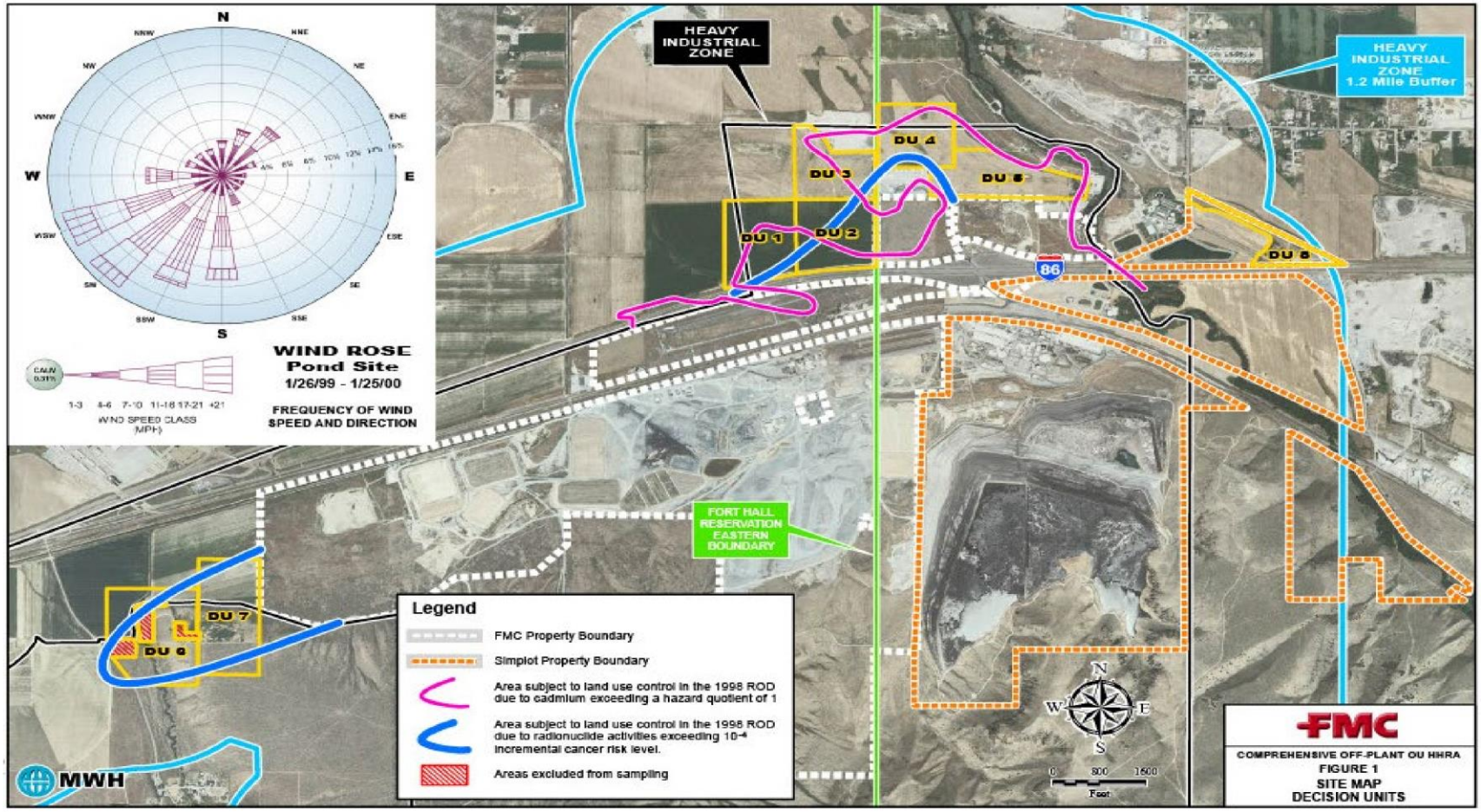


Figure 6

DECISION UNITS FOR SUPPLEMENTAL OFF-PLANT OU SOILS SAMPLING AND ANALYSIS